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# FADING PITCH MEASURING APPARATUS, FADING PITCH MEASURING METHOD AND PORTABLE INFORMATION TERMINAL USING THEM

## TECHNICAL FIELD

[0001] The present invention relates to a fading pitch detection apparatus in a mobile communication system and the method for detecting a fading pitch, and a mobile information terminal using the apparatus and the method.

## BACKGROUND ART

[0002] In a mobile communication system, fading means the variations of a reception signal corresponding to changes in the speed of a mobile terminal and a standing wave. Such controls as mentioned below may be achieved based upon the fading pitch thereof. For example, for controlling transmission power, a transmission power control period may be determined based upon the fading pitch. As a result, transmission power may be controlled efficiently to deal with variations in the reception level of the signal caused by the fading.

[0003] Furthermore, in a CDMA (Code Division Multiple Access)-system based communication, a reception symbol is detected by calculating the carrier wave phase by weighting and synthesizing transmission line estimation values obtained from a plurality of pilot symbols. In this case, an optimal weight may be selected based upon the fading pitch.

[0004] Still more, in the CDMA-system based communication, the timing of an incoming path is detected by calculating a correlation between a reception signal and a specific code and then averaging this correlation. In this case, an averaging time, a measurement interval, and the like in the measurement of the correlation may be optimized based upon the fading pitch. As a result, power consumption may be reduced.

[0005] Still further, with a mobile terminal, the moving speed is obtained by the product of a fading pitch multiplied by the wavelength of a carrier wave. Therefore, the moving speed of a terminal may be obtained by detecting the fading pitch, which may contribute to establishing various types of wireless channels.

[0006] As a conventional fading pitch detection apparatus, FIG. 10 shows a first conventional art as an example. FIG. 10 is a block diagram of a conventional fading frequency (pitch) detection apparatus, which is disclosed in Japanese Unexamined Patent Publication No. Hei9-135215. Referring to the FIG., a reference numeral 51 denotes branches 1 to n for receiving a multiple number of reception waves which may appear to have no correlation to one another. The multiple number of branches 51 correspond to a plurality of antennas, for example. A reference numeral 52 denotes a synthesizing means, which is configured by hybrid circuits, for generating a synthesized reception wave by synthesizing the electric-field strength of a reception wave arriving at the respective branches 51 with a proper phase difference for maintaining the constancy of the distribution of the electric-field strength. With the thus generated synthesized reception wave, the distribution of the electric-field strength is maintained, which is relative to the multiple number of reception waves. In addition to that, all the fading accompanying those

reception waves are multiplexed, so that a seeming fading pitch becomes higher than the fading pitch of an actually arriving reception wave.

[0007] A reference numeral 53 denotes a measuring means for obtaining a fading pitch by calculating the number of times per unit time the fading occurs with the synthesized reception wave. A reference numeral 54 denotes a conversion means for calculating the fading pitch of a reception wave actually arriving at the respective branches 51 by multiplying the obtained fading pitch by a predetermined numeric value. The predetermined numeric value is the ratio of the fading pitch of the synthesized reception wave to the fading pitch of the reception wave arriving at one of the branches. The predetermined numeric value is obtained through actual measurement or simulation based upon the wireless transmission line model of the reception wave.

[0008] According to this conventional art, a fading pitch is measured of a synthesized reception wave having a higher frequency in having the fading occurred than an actual reception wave arriving at the respective branches. Then, the fading pitch measured is used for calculating the fading pitch of an actually arriving reception wave at the respective branches 51. As a result, a fading pitch may be measured accurately in a short time.

[0009] Furthermore, as another conventional fading pitch detection apparatus, FIG. 11 shows a second conventional art as an example. FIG. 11 is a block diagram of a conventional fading pitch detection apparatus disclosed in Japanese Unexamined Patent Publication No. Hei8-79161. Referring to the FIG., a reference numeral 61 denotes a radio section for receiving a radio wave. A reference numeral 62 denotes a level detection section for detecting the reception level of the reception signal based upon a timing signal generated in a given cycle. Then, a sampling is performed in an A/D (analog/digital) converter 63 by converting a detected reception level into a digital value. A reference numeral 64 denotes a storage section for holding previously sampled reception signals for each sampling. A reference numeral 65 denotes a difference detection section for calculating a difference between a currently sampled reception level and the previously sampled reception level for each sampling. A reference numeral 66 denotes an accumulating section for obtaining an accumulated value by accumulating the differences successively received for a given period of time.

[0010] It is already known that there is a correlation between this accumulated value and a fading pitch. Thus, a correlation table between the fading pitch and the accumulated value is provided previously through experiments. A reference numeral 67 denotes a fading pitch detecting section for converting the accumulated value obtained in the accumulating section 66 into a fading pitch by means of the previously provided correlation table.

[0011] According to this conventional art, the accumulated value is obtained by accumulating the differences for a given period of time. For that reason, the accumulated value delicately changes according to the value of a difference. As a result, a high-precision fading pitch may be detected.

[0012] According to the first conventional fading pitch detection apparatus, the plurality of branches is required for receiving reception waves which may appear to have no correlation to one another. However, the plurality of

First Hit**End of Result Set**

L9: Entry 2 of 2

File: DWPI

May 20, 1997

DERWENT-ACC-NO: 1997-330763

DERWENT-WEEK: 199736

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TITLE: Frequency measurement appts for mobile communication system - has conversion unit which determines deterioration frequency of received wave which is actually received at branches

PATENT-ASSIGNEE: FUJITSU LTD (FUIT)

PRIORITY-DATA: 1995JP-0290860 (November 9, 1995)

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## PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
<input type="checkbox"/> JP 09135215 A	May 20, 1997		006	H04B017/00

## APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP 09135215A	November 9, 1995	1995JP-0290860	

INT-CL (IPC): H04 B 7/26; H04 B 17/00

ABSTRACTED-PUB-NO: JP 09135215A

## BASIC-ABSTRACT:

The frequency measurement appts determines the frequency of signal deterioration in a mobile communication system. A synthetic unit (11) receives the signal transmitted from a number of branches (101-10n). The signals are combined maintaining the distribution of field strength regularly, such that a synthetic wave is formed. The deterioration frequency of the synthetic wave that is output by the synthetic unit is measured by a measurement unit (12).

The deterioration of the field strength of synthetic wave per unit time is monitored by the measurement unit, which is multiplied by a constant ratio based on the deterioration frequency of the individual signals obtained by each branch. A conversion unit (13) determines the deterioration frequency of the reception wave which actually arrives at the branches.

ADVANTAGE - Measures deterioration frequency of signal accurately. Shortens measurement time. Improves efficiency and reliability. (Reissued from week 9730 for reprint into week 9736 to provide Abstract)

ABSTRACTED-PUB-NO: JP 09135215A

## EQUIVALENT-ABSTRACTS:

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-135215

(43)Date of publication of application : 20.05.1997

(51)Int.Cl.

H04B 17/00

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(21)Application number : 07-290860

(71)Applicant : FUJITSU LTD

(22)Date of filing : 09.11.1995

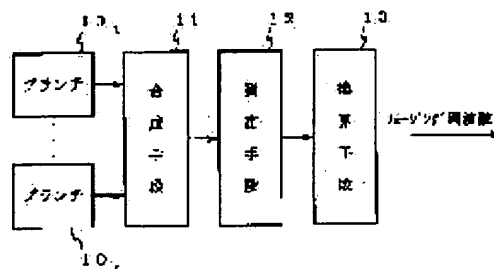
(72)Inventor : ASANO MASAHIKO  
KOBAYAKAWA SHIYUJI  
SEKI HIROYUKI  
TODA TAKESHI

## (54) PHASING FREQUENCY MEASURING DEVICE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a phasing frequency measuring device capable of accurately measuring a phasing frequency in a short time with respect to the phasing frequency measuring device measuring the number of phasing times generated per unit time.

**SOLUTION:** The device consists of plural branches 101 to 10n and a synthesizing means 12 generating a synthesized reception wave by synthesizing plural reception waves, which income to the plural branches 101 to 10n and can be judged to be not-correlated to one another, while maintaining the constance of distribution of electronic field intensity. The device is also provided with a measuring means 12 measuring the phasing frequency of the synthesized reception wave and a conversion means 13 obtaining the phasing frequency of the reception wave actually incoming to the branches 101 to 10n by multiplying the ratio of the phasing frequency obtained based on observation and simulation concerning the reception wave which can income to one of the branches 101 to 10n and the synthesized reception wave which can be generated by the synthesizing means 11 to the phasing frequency measured by the measuring means 12.



## LEGAL STATUS

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**CLAIMS**

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[Claim(s)]

[Claim 1] A phasing frequency measuring device characterized by providing the following. Two or more branches A synthetic means to incorporate two or more received waves arrive at said two or more branches according to an individual, and it can consider no correlating mutually, and to compound, maintaining the constancy of distribution of field strength by these received waves, and to generate a synthetic received wave A measurement means to carry out counting of the count per unit time amount of phasing which supervises field strength of a synthetic received wave generated by said synthetic means, and is generated on the synthetic received wave, and to measure phasing frequency A conversion means to obtain phasing frequency of a received wave which multiplies phasing frequency measured by said measurement means by ratio of phasing frequency beforehand called for according to an individual in parallel based on an observation or a simulation about a received wave which arrives at any of two or more of said branches they are, and a synthetic received wave generated by said synthetic means, and actually arrives at two or more of the branches

[Claim 2] A phasing frequency measuring device characterized by providing the following. Two or more branches A synthetic means to generate two synthetic received waves incorporate two or more received waves arrive at said two or more branches according to an individual, and it can consider no correlating mutually, and compound, maintaining the constancy of distribution of field strength by these received waves, and it can consider no correlating mutually A measurement means to carry out counting of the count per [ which measures field strength of two synthetic received waves generated by said synthetic means, and both size relation reverses ] unit time amount, to multiply by proportionality constant for which the count was asked theoretically beforehand, and to measure phasing frequency of these synthetic received waves A conversion means to obtain phasing frequency of a received wave which multiplies phasing frequency measured by said measurement means by ratio of phasing frequency beforehand called for according to an individual in parallel based on an observation or a simulation about one side of a received wave which arrives at any of two or more of said branches they are, and a synthetic received wave generated by said synthetic means, and actually arrives at two or more of the branches

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the phasing frequency measuring device which measures the count generated in per unit time amount about phasing produced according to fluctuation of the transmission characteristic of a radio-transmission way in migration communication system.

[0002]

[Description of the Prior Art] In the base station of migration communication system, the phasing frequency of the received wave which comes from a mobile station is measured, and various radio-channel setting control is performed based on the gestalt and procedure which were adapted for the passing speed of the mobile station obtained by the product of the wavelength of the received wave, and phasing frequency.

[0003] Drawing 5 is drawing showing the example of a configuration of the conventional phasing frequency measuring device. In the phasing frequency measuring device shown in drawing 5 (a), a control section 51 measures the field strength of the received wave which arrived at the antenna 50 a fixed period. Moreover, a control section 51 asks for phasing frequency by carrying out counting of the count per [ to which the difference of the value measured by doing in this way exceeds the threshold given beforehand ] unit time amount.

[0004] Moreover, with the phasing frequency measuring device shown in drawing 5 (b), it is an antenna 521 and 522. It is installed in the location which was far apart in the degree with which the cross-correlation of the received wave which comes according to an individual may be disregarded, and a switch 53 is given to the receive section which always chooses the one between two received waves which arrived at these antennas where field strength is larger, and is not illustrated. A control section 54 asks for phasing frequency by multiplying by the proportionality constant (= 1.3) for which the count from which the contact of a switch 53 changes to per unit time amount according to such selection was asked theoretically beforehand.

[0005]

[Problem(s) to be Solved by the Invention] However, in such a conventional example, when a mobile station moves at a low speed, in order for the frequency which phasing generates to decrease and to maintain precision highly, the period to measure needed to be set up for a long time.

[0006] Moreover, since setting up the period which rapidity was required and was mentioned above about the radio-channel setting control in connection with the mobile station which moves at high speed for a long time was not permitted, it was difficult to measure phasing frequency in sufficient precision. This invention aims at offering the phasing frequency measuring device which can measure phasing frequency in a high precision to short time amount.

[0007]

[Means for Solving the Problem] Drawing 1 is the principle block diagram of invention according to claim 1. Invention according to claim 1 incorporates two or more received waves arrive at two or more branches 101-10n and said two or more branches 101-10n according to an individual, and it can consider no correlating mutually. A synthetic means 11 to compound maintaining the constancy of distribution of field strength by these received waves, and to generate a synthetic received wave, A measurement means 12 to carry out counting of the count per unit time amount of phasing which supervises field strength of a synthetic received wave generated by said synthetic means 11, and is generated on the synthetic received wave, and to measure phasing frequency, About a received wave which arrives at said branches [ two or more / 101-10n ] any they are, and a synthetic received wave generated by said synthetic means 11 Phasing frequency measured by said measurement means 12 is multiplied by ratio of phasing frequency beforehand called for according to an individual in parallel based on an observation or a simulation. It is characterized by having a conversion means 13 to obtain phasing frequency of a received wave which actually arrives at two or more of the branches 101-10n.

[0008] Drawing 2 is the principle block diagram of invention according to claim 2. Invention according to claim 2 incorporates two or more received waves arrive at two or more branches 101-10n and said two or more branches 101-10n according to an individual, and it can consider no correlating mutually. A synthetic means 20 to generate two synthetic received waves compound, maintaining the constancy of distribution of field strength by these received waves, and it can consider no correlating mutually, Counting of the count per [ which measures field strength of two synthetic received waves generated by said synthetic means 20, and both size relation reverses ] unit time amount is carried out. A measurement means 21 to multiply by proportionality constant for which the count was asked theoretically beforehand, and to measure phasing frequency of these synthetic received waves, About one side of a received wave which arrives at said branches [ two or more / 101-10n ] any they

are, and a synthetic received wave generated by said synthetic means 20 Phasing frequency measured by said measurement means 21 is multiplied by ratio of phasing frequency beforehand called for according to an individual in parallel based on an observation or a simulation. It is characterized by having a conversion means 22 to obtain phasing frequency of a received wave which actually arrives at two or more of the branches 101-10n.

[0009] In a phasing frequency measuring device in connection with invention according to claim 1, two or more received waves it can consider no correlating mutually arrive at two or more branches 101-10n, and the synthetic means 11 compounds field strength of these received waves, maintaining the constancy of the distribution, and generates a synthetic received wave. About such a synthetic received wave, since distribution of field strength is preserved to two or more received waves mentioned above and it is superimposed on all phasing accompanying these received waves, phasing frequency on appearance becomes higher than actual phasing frequency.

[0010] The measurement means 12 carries out counting of the count per unit time amount of phasing accompanying the synthetic received wave, and asks for phasing frequency. Moreover, the conversion means 13 multiplies by ratio of phasing frequency for which phasing frequency called for by the measurement means 12 was asked in parallel by simulation based on an observation or a model set up beforehand about a synthetic received wave which does in this way and is generated by the synthetic means 11, or a received wave which arrives at Branches 101-10n, and is 101-10n of branches of these plurality. Phasing frequency of a received wave which actually comes is computed.

[0011] Therefore, the short measuring time is asked for phasing frequency of a received wave with a sufficient precision. In a phasing frequency measuring device in connection with invention according to claim 2, two or more received waves it can consider no correlating mutually arrive at two or more branches 101-10n, and the synthetic means 20 generates two synthetic received waves it can consider no correlating mutually by compounding field strength of these received waves, maintaining the constancy of the distribution. About such two synthetic received waves, since distribution of field strength is preserved to two or more received waves mentioned above and it is superimposed on all phasing accompanying these received waves, phasing frequency on appearance becomes higher than actual phasing frequency. The measurement means 21 carries out counting of the count per [ which size relation of these two synthetic received waves reverses ] unit time amount, and asks for phasing frequency by multiplying by proportionality constant for which the count was asked theoretically beforehand. Moreover, the conversion means 22 multiplies by ratio of phasing frequency for which phasing frequency called for by the measurement means 21 was asked in parallel by simulation based on an observation or a model set up beforehand about any of any of a synthetic received wave which does in this way and is generated by the synthetic means 20 they are, and a received wave which arrives at Branches 101-10n, and computes the phasing frequency of a received wave which actually arrives at the branches 101-10n of these plurality.

[0012] Therefore, the measuring time with short phasing frequency of a received wave is asked with a sufficient precision.

[0013]

[Embodiment of the Invention] Hereafter, based on a drawing, details are explained about the operation gestalt of this invention.

[0014] Drawing 3 is drawing showing the operation gestalt corresponding to invention according to claim 1. The difference of a configuration with the conventional example shown in this operation gestalt and drawing 5 (a) is in the point that replaced with the antenna 50, and antennas 301 and 302 were formed, replaced with the control section 51, the control section 32 was formed, and the hybrid circuit 31 was formed between the electric supply edge of these antennas 301 and 302, and the input of a control section 32.

[0015] In addition, about correspondence relation with the block diagram shown in this operation gestalt and drawing 1, antennas 301 and 302 correspond to Branches 101-10n, a hybrid circuit 31 corresponds to the synthetic means 11, and a control section 32 corresponds to the measurement means 12 and the conversion means 13.

[0016] Hereafter, actuation of this operation gestalt is explained. Two small received waves arrive at antennas 301 and 302 in parallel at the degree with which a cross-correlation may be disregarded, and a hybrid circuit 31 compounds these received waves by fixed phase contrast, and generates a synthetic received wave. Such a synthetic received wave becomes being the same as that of two received waves which distribution of field strength mentioned above by setting the phase contrast mentioned above as a proper value, and since the field strength of a synthetic received wave is further obtained as the vector sum of two received waves, the frequency which phasing generates increases.

[0017] Moreover, one phasing frequency of such a synthetic received wave and two received waves mentioned above is called for by the simulation based on the model of an observation or the radio-transmission way of these received waves, and both ratio is computed beforehand. A control section 32 asks for the phasing frequency of the received wave which actually arrived at antennas 301 and 302 indirectly by multiplying by the ratio which measured phasing frequency and was mentioned above in the phasing frequency by performing the same processing as the conventional example shown in the synthetic received wave at drawing 5 (a).

[0018] Therefore, in this operation gestalt, about measurement of phasing frequency, since a synthetic received wave with much frequency which phasing generates serves as the measuring object, when the same measuring time as usual is set up, a high precision is acquired, and when the same precision as usual is maintained, compaction of the measuring time can be aimed at. In addition, although the same procedure as the conventional example shown in drawing 5 (a) is applied with this operation gestalt in order to measure phasing frequency In this invention, if it is the method of asking for phasing frequency based on the electrolysis reinforcement of not only procedure such but one received wave For example, what kind of methods, such as the calculation method which multiplies the value which measured the field strength of a received wave the fixed period, and integrated the absolute value of the difference by the predetermined proportionality coefficient, may be used.

[0019] Moreover, although a synthetic received wave is generated under fixed phase contrast with this operation gestalt, if a synthetic received wave with high phasing frequency is generated distribution of the field strength of two received waves mentioned above being preserved, such phase contrast may not be fixed. Drawing 4 is drawing showing the operation gestalt corresponding to invention according to claim 2. In drawing, about what has the thing, the the same function, and the same configuration which are shown in drawing 5 (b), the same sign is given and shown and the explanation is omitted here.

[0020] It replaces with a control section 54, a control section 41 is formed, and the difference of a configuration with the conventional example shown in this operation gestalt and drawing 5 (b) is in the point that the hybrid circuit 40 has been arranged between the electric supply edge of antennas 521 and 522, and the input of a switch 53. In addition, about correspondence relation with the block diagram shown in this operation gestalt and drawing 2, antennas 521 and 522 correspond to Branches 101-10n, a hybrid circuit 40 corresponds to the synthetic means 20, a switch 53 corresponds to the measurement means 21, and a control section 41 corresponds to the measurement means 21 and the conversion means 22.

[0021] Hereafter, actuation of this operation gestalt is explained. At antennas 521 and 522, two small received waves arrive at the degree with which a cross-correlation may be disregarded in parallel, a hybrid circuit 40 compounds these two received waves by two phase contrast which is fixed and is different, and two small synthetic received waves are generated to the degree with which a cross-correlation may be disregarded.

[0022] Thus, although the frequency which phasing generates increases since two synthetic received waves which may be generated become being the same as that of two received waves which distribution of field strength mentioned above by setting two phase contrast mentioned above as a proper value and the field strength of a synthetic received wave is further obtained as the vector sum of two received waves, a cross-correlation is small suppressed by the degree which may be disregarded.

[0023] One [ one side of such two synthetic received waves and ] phasing frequency of two received waves which may arrive at the branch mentioned above is called for by the simulation based on the model of an observation or the radio-transmission way of these received waves, and both ratio is computed beforehand. A control section 41 asks for the phasing frequency of two received waves which actually arrived at antennas 521 and 522 indirectly by multiplying by the ratio which measured phasing frequency and was mentioned above in the phasing frequency by performing the same processing as the conventional example shown in two synthetic received waves at drawing 5 (b).

[0024] Therefore, in this operation gestalt, about measurement of phasing frequency, since a synthetic received wave with much frequency which phasing generates serves as the measuring object, when the same measuring time as usual is set up, a high precision is acquired, and when the same precision as usual is maintained, compaction of the measuring time can be aimed at. In addition, although two synthetic received waves are generated with this operation gestalt under two phase contrast which is fixed and is different, if two synthetic received waves with phasing frequency small to the degree with which a cross-correlation may be disregarded highly are generated distribution of the field strength of two received waves mentioned above being preserved, such two phase contrast may not be fixed.

[0025] Moreover, with each operation gestalt mentioned above, although a synthetic received wave is generated through a hybrid circuit, if it has a property equivalent to the hybrid circuit, what kind of synthetic vessel of a circulator and others may be used. Furthermore, although the received wave which arrived at two branches is compounded with each operation gestalt mentioned above, if the ratio beforehand shown in each operation gestalt based on the observation or the simulation is obtained, the number of branches may be more than "3."

[0026]

[Effect of the Invention] A synthetic received wave with much frequency which phasing generates by compounding maintaining the constancy of the distribution of field strength by the received wave which arrives at two or more branches in claim 1 and invention according to claim 2 as mentioned above is generated, and since processing of the conversion which were adapted for the phasing frequency of the synthetic received wave at the method of such composition is performed, it becomes possible to measure phasing frequency with a sufficient precision promptly.

[0027] Therefore, in the migration communication system to which this invention was applied, based on such phasing frequency, a high speed is asked for the passing speed of a mobile station in a high precision, and the effectiveness and reliability of radio-channel setting control are raised.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The principle block diagram of invention according to claim 1

[Drawing 2] The principle block diagram of invention according to claim 2

[Drawing 3] Drawing showing the operation gestalt corresponding to invention according to claim 1

[Drawing 4] Drawing showing the operation gestalt corresponding to invention according to claim 2

[Drawing 5] Drawing showing the example of a configuration of the conventional phasing frequency measuring device

[Description of Notations]

10 Branch

11 20 Synthetic means

12 21 Measurement means

13 22 Conversion means

30, 50, 52 Antenna

31 40 Hybrid circuit

32, 41, 51, 54 Control section

53 Switch

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[Translation done.]

## \* NOTICES \*

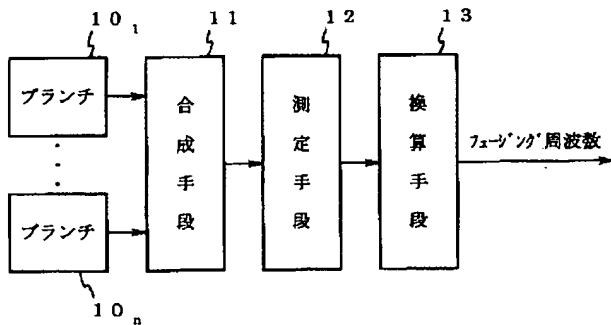
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## DRAWINGS

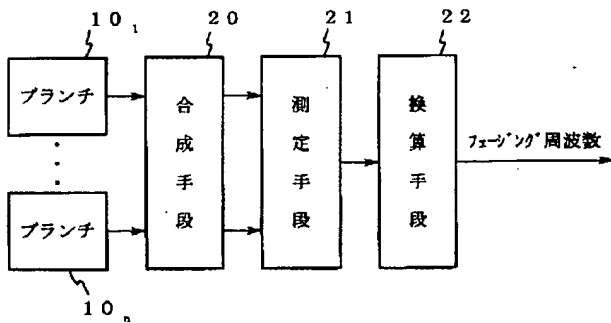
[Drawing 1]

請求項 1 に記載の発明の原理ブロック図



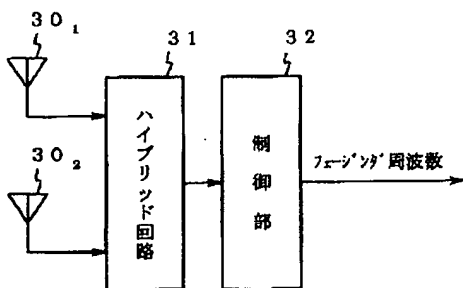
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請求項 2 に記載の発明の原理ブロック図



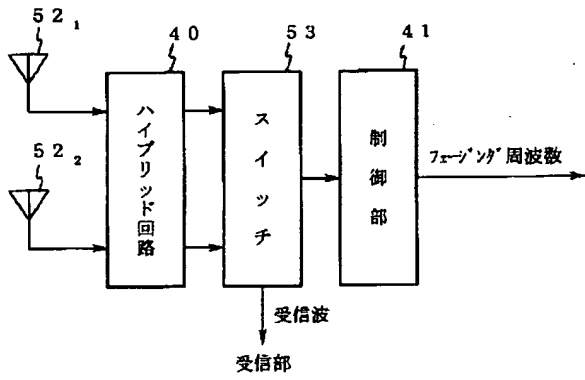
[Drawing 3]

請求項 1 に記載の発明に対応した実施形態を示す図



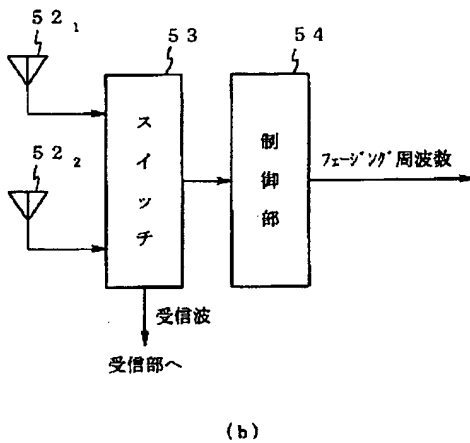
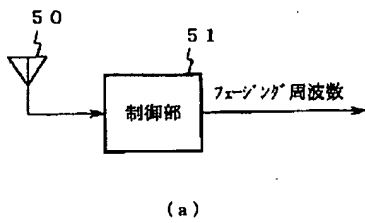
[Drawing 4]

請求項2に記載の発明に対応した実施形態を示す図



[Drawing 5]

従来のフェージング周波数測定装置の構成例を示す図



[Translation done.]